

Knowledge-Sharing in an Online Community of Health-care Professionals

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Structured Abstract

Purpose – The purposes of this study are twofold: (1) to examine the types of activity that nurses undertake on an online community of practice (APN-I) as well as the types of knowledge that nurses share with one another and (2) to examine the factors that sustain knowledge sharing among the nurses from their local perspectives.

Design/methodology/approach – An in-depth case study with mixed methods was adopted to obtain rich and naturalistic data including online observations of the messages posted in APN-I, interviews with twenty-seven members of APN-I, and content analysis of online messages.

Findings – The most common type of activity performed by members of APN-I was “Knowledge sharing,” followed by “Solicitation.” Regarding the types of knowledge shared, the most common were “Institutional practice” and “Personal opinion.” The factors that have helped sustain knowledge sharing within the online community of practice include: (1) a self-selection, (2) validation of one’s practice with others who share a similar working situation, (3) a need to gain better understanding of current knowledge and best practices in the field, (4) a non-competitive environment, (5) the asynchronous nature of the online communication medium, and (6) the role of the listserv moderator.

Originality/value – This study contributes to the growing knowledge base of communities of practice that span organizational boundary. Administrators can use the coding schema developed in this study to gauge current activities of existing online communities of practice. Additionally, they can use the six factors to sustain knowledge sharing community for fostering new/existing online communities of practice.

Keywords: knowledge sharing, online communities of practice, types of knowledge, nurses

Introduction

Organizations and professional associations are increasingly examining the potential of online communication networks to enable members to share knowledge and engage in continuing workplace learning and professional development (Gray, 2004; Wasko & Faraj, 2005). The notion of communities of practice as a milieu for knowledge sharing has gained significant ground in recent years (Smith, 2003; Hung, Tan, Hedberg, & Koh, 2005), particularly in the corporate world (Ruhleder, Jordan, & Elmes, 1996; Wenger & Snyder, 2000). According to Wenger, Dermott, and Snyder (2002), communities of practice can be described as “groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis” (p. 4).

Among the main reasons why communities of practice are effective tools for knowledge sharing is the fact that much of an individual’s knowledge is intangible and tacit in character (Ardichvili, Page, & Wentling, 2003). Tacit knowledge, defined as knowledge that is understood without being stated (Biggam, 2001), has a personal quality which makes it hard to formalize (Polanyi, 1966). Tacit knowledge has been observed in embedded form within the stories people tell (Horvath, 1999). Consequently, one of the methods to help people share and internalize tacit knowledge is to allow them to talk about their experiences (Ardichvili et al., 2003). Since holding face-to-face interactions on a regular basis can be costly and time consuming, online communities of practice supported by Internet technologies are among the few viable alternatives to live conversation and knowledge sharing (Ardichvili et al., 2003; Dubé, Bourhis, & Jacob, 2005). Perhaps the most closely related development of a framework for online knowledge sharing is “Cyber Ba” by Nonaka & Konno (1998). However, Cyber Ba is a part of the SECI

model¹, which explains the conversion of tacit knowledge to explicit knowledge. Cyber Ba provides an environment for distributing explicit knowledge to others as explicit knowledge. This model does not address the issues of collective learning and identity formation that are both core components of the communities of practice concept.

There have been studies of communities of practice involving technicians (Orr, 1996), claim processors (Wenger, 1990), defense lawyers (Hara, 2000), telecommunication engineers (Yi, 2000), consultants (Chao, 2001; Haney, 2003), teachers (Baek, 2002; Barab, MaKinster, & Scheckler, 2003), and reference service users (Davenport, 2001), to name a few. However, the majority of previous studies were conducted within a single organizational context, and only a few recent studies of communities of practice cross organizational boundaries. Our present study that involves nurses from many various nursing institutions helps contribute to the growing knowledge base of communities of practice that span organizational boundary.

Moreover, little documented research categorizes the different types of knowledge that people share with one another. Several studies that addressed knowledge sharing have been conducted. For example, Wasko and Faraj (2000) examined why people contributed to the provision of knowledge as a public good in online communities of practice but stopped short of investigating the types of knowledge that were shared. Similar trends were found in other studies (e.g., Ardichvili, et al., 2003; Hendriks, 1999). Previous studies have not addressed the types of knowledge or factors that can help sustain knowledge sharing in communities.

The main purpose of this study is to extend research on online communities of practice in three ways. First, it categorizes and describes the different types of activities and knowledge shared. This helps contribute to a greater understanding of the activities and types of shared knowledge that may characterize an online community of practice. Second, it contributes to an

¹ SECI stands for socialization, externalization, combination, and internalization (Nonaka & Takeuchi, 1995).

understanding of the factors that can sustain knowledge sharing among members of an online community of practice. Very few prior studies addressed the pertinent factors that can help sustain long-term knowledge sharing within a community of practice environment. For example, the focus of Baek's (2002) study was primarily on the *initial design* of a web-supported teachers' community of practice. Huysman and Wulf (2006) have contended that more studies are needed to examine informal knowledge sharing in communities—a turn they have dubbed the second generation of knowledge management. Third, the current study used the local/emergent approach, which complements other studies on knowledge sharing such as Wasko and Faraj's (2005) study that used *a priori* framework. Factors addressed by informants might be different from the ones identified by theoretical frameworks.

This article is organized as follows: the first section presents a brief discussion of what a community of practice is, followed by how knowledge sharing may occur online, and the types of knowledge that may be shared; the second section presents the methodology; this is followed by the findings and discussion, and conclusions of the study.

Literature Review

Cox (2005) has compared different definitions of communities of practice stated by the original work of Lave and Wenger (1991), Brown and Duguid (1991), Wenger (1998), and Wenger, McDermott, and Snyder (2002). In this study, we used Wenger's (1998) definition because our focus on this study is knowledge sharing through learning and identity development (Wenger, 1998), and not on innovation (Brown & Duguid, 1991), management of communities of practice (Wenger et al., 2002) or legitimate peripheral participation (Lave & Wenger, 1991). Thus, we arrived at four main characteristics that define a community of practice based on Wenger's seminal work (Wenger, 1998): practice, community, meaning, and identity. First,

learning takes place in practice. Put simply, learning is achieving through doing. Second, learning occurs as being a member of a community. Membership implies a minimum level of knowledge of that domain—a shared competence that distinguishes members from other people. Through membership in a community, members learn the knowledge embedded within that community. Third, learning is a part of experience and, as a result, becomes meaningful. Without the experience, learning becomes abstract and less meaningful. Fourth, through practice and meaningful learning in a community, members of such communities develop an identity. The individual members learn how to become a member of a professional community. Members of a community of practice engage in joint activities and discussions, help each other, and share information. Through such interactions, they form a community around their domain and build relationships with one another. Whether it is a group of high school teachers or a community quilting club, a community of practice consists of individuals with a shared domain of expertise who voluntarily learn together about practices that matter to them (Gray, 2004). Gray further argued that shared learning and interests are what keep communities of practice together.

An important conduit for knowledge sharing among members in communities of practice is conversation (Sharratt & Usoro, 2003; Zeldin, 1998; Orr, 1996). In the case of an online community, the “conversation” associated with knowledge sharing typically involves the knowledge seeker posting an open question or a request for help to the community via a listserv or online forum. In response, a knowledge provider may either share his or her knowledge in the form of a story describing a similar experience where a method was used to solve a problem or, if unable to provide an appropriate solution, share knowledge indirectly by referring the individual to someone else who might know and be willing to help. What then are the types of knowledge that are being shared?

Traditionally, researchers have distinguished between tacit and explicit knowledge (Wensley, 2000). Tacit knowledge can be taken as the implicit, semiconscious and unconscious knowledge held in people's heads (Leonard & Sensiper, 1998) while explicit knowledge refers to knowledge that is expressed (Biggam, 2001). Other scholars have resorted to alternative formulations. For example, Hildreth, Kimble, and Wright (2000) differentiate between "hard" and "soft" knowledge: "Hard knowledge is knowledge that can be easily articulated and captured. Soft knowledge on the other hand is not so easily articulated and cannot be so readily captured" (p. 28). Hara (2007), in her study of two communities of practice involving public defenders, has offered still another model based on three broad types of knowledge: book knowledge, practical knowledge, and cultural knowledge. In her formulation, book knowledge refers to an individual's awareness of knowledge about mere facts such as statutes, policies, and standards. Practical knowledge implies book knowledge applied into practice, which includes know-how; for example, how to use certain statutes or similar prior cases for a specific case in a trial. Cultural knowledge is about what it is like to be a defense attorney and includes *both* one's belief toward a practice, as well as one's professional responsibilities in a practice (including job description). For example, cultural knowledge related to a defense attorney would entail beliefs regarding the practice (e.g., I want everyone in the U.S. to have the constitutional right to have an attorney representative), and professional responsibilities (including job description) associated with defending criminals (e.g., negotiating with prosecutors and judges and developing strategies for trials). These knowledge types emerged based on her ethnographic study of communities of practice.

In this study, Hara's (2007) conceptualization of knowledge types was adopted, rather than the tacit-explicit knowledge dichotomy. This is because the tacit-explicit knowledge

dichotomy does not, for our purposes, yield a proper understanding of what constitutes knowledge but merely illustrates that knowledge can either be expressed or remain undeclared (Biggam, 2001). Knowledge is not always binary, but exists along a continuum of tacitness and explicitness (Kogut & Zander, 1993). Keane and Mason (2006) argue that the use of the explicit-tacit dichotomy to represent knowledge types is a misinterpretation of Polanyi's (1966) work. They argue that according to Polanyi's definition, tacitness is a dimension of knowledge, not a type; hence their statement that "all knowledge is composed of both tacit and explicit *dimensions* (not *types*)" (p. 1). This is another reason for not adopting the tacit/explicit dichotomy in this study. The "hard" and "soft" knowledge dichotomy is not used because it is very similar to the explicit-tacit dichotomy; where "hard" corresponds to explicit and "soft" corresponds to tacit.

The following research questions (RQs) were addressed: RQ-1 (a) what types of activity did the nurses engage in on the listserv, and (b) what types of knowledge did the nurses share with one another? The reason we investigated the RQ-1 (a) is because we intended to exclude activities that are different from knowledge sharing in the analysis to examine the types of knowledge shared among the nurses.

Knowledge sharing in online environments has been studied in the past. For example, Wasko and Faraj (2005) examined motivations for legal professionals to share knowledge in a listserv. Their study examined and tested an *a priori* model derived from social capital, yet their findings strongly confirmed only two out of seven hypotheses. Similarly, Ling, Beenen, Ludford, Wang, Chang, Li, et al. (2005) investigated motivation for people to share knowledge on an online movie review site. Their findings indicated that more knowledge contribution occurs when members believe that their contribution is unique and when they are given specific-goals. Their study also confirmed a mere two out of eight hypotheses. In surveying the literature in

knowledge management, Schultze and Leidner (2002) found that the majority of studies are based on elite perspective, i.e., researchers used theoretical or *a priori* frameworks for traditional hypothesis testing purposes (e.g., to test and validate a particular pre-determined model of knowledge sharing), rather than ones based on local perspective, that is studies with findings that emerge from informants. Although both perspectives are needed, studies with local informants' perspectives in knowledge management are disproportionately fewer than studies that use *a priori* frameworks. If researchers only use *a priori* frameworks, some of the important aspects of the phenomena might be overlooked.

The two studies (Wasko & Faraj, 2005; Ling et al., 2005) illustrate the limitations of using an *a priori* framework to examine knowledge sharing phenomena in online environments. Moreover, Ling et al.'s study was conducted in an artificial setting, i.e., their movie rating website was created just for the purpose of studies, not naturally developed. In this study, we identified a long standing online community of practice and examined a second research question: RQ-2; what are the factors that sustain knowledge sharing among the nurses from their perspectives? Although RQ-1 in this study uses an *a priori* framework emerged in Hara's (2007) previous research (i.e., types of knowledge), the purpose of our current study is different from the traditional hypothesis testing approach as described in Schultze and Lediner (2002). Rather, we use the data from the current study to refine our understanding of the types of knowledge (e.g., book, practical, and cultural knowledge) that may be shared by the nurses.

Methods and Data

A single in-depth case study with mixed methods was adopted to obtain rich and naturalistic data (Yin, 2003). According to Merriam (2001), a case study is utilized when the researcher seeks to gain a comprehensive understanding of a situation. This approach is suitable

given that the key purpose of this study is to allow us to gain an understanding of knowledge sharing among nurses in an online listserv, rather than to make generalizations or prove/disprove underlying hypotheses. The qualitative methods included the use of online observations and interviews. The quantitative method included the use of descriptive statistics (e.g., mean and percentage) to report the types of activity and knowledge data. Additionally, we calculated the response to query ratio to further explore and determine if the listserv demonstrated an active query-response discussion forum.

Our search for a suitable research site led us to an online listserv involving professional nurses in critical care and advanced practice disciplines, namely the Advanced Practice Nurses listserv (subsequently called APN-1). It is one of the oldest nursing listservs in the United States. The availability of such a research site affords us the unique opportunity of understanding how knowledge sharing within the listserv was sustained over the course of a decade.

Brief Description of the Case

The APN-1 is open to all clinical nurse specialists, advanced practice nurses, educators, administrators, physicians, and other professionals interested in advanced practice nursing critical care; individuals can post queries at any time or place to network with one another by sending an email to an APN-1 address. The moderator screens membership applications to the listserv, as well as messages to reduce the number of advertising and other inappropriate postings. No attachments are allowed in the messages in order to prevent the spread of viruses. APN-1 was founded in 1993; as of February 2006, there were more than 1,310 members from all parts of the country participating in various discussions. APN-1 originally began as a MS-DOS-based listserv at a research university with 100 members before moving to the *Yahoo! Group software* platform in 2001. All new members to the APN-1 are informed of netiquette to facilitate

good communications among members. The rules include: (1) posting messages that are germane to advanced and critical care nursing practice only; (2) when replying to a message, including only the relevant part of the original message; (3) if in a continuing disagreement with another member, using individual email; (4) use of a “signature” at the end of member messages with name, address, and affiliation; (5) avoiding offensive language; and (6) keeping messages short and to the point.

Although APN-I is an emailing list, there is a repository of old messages for members to refer to if they want. There are two features available in the repository—sorting archived messages individually by date or by discussion topic. By using the latter feature, archived messages can be viewed in threaded format, though this requires logging on to the archive database.

Data Collection

Permission to conduct the study was sought and obtained from the moderator of APN-I. Data were gathered on APN-I through two primary means—online observations and interviews.

Online observation. According to Foster (1996), the advantages of observational work include the following: information about human behavior can be recorded directly without having to rely on the retrospective or anticipatory accounts of others; patterns and regularities in the environment may be observed and analyzed over time; observation can give access to information about people who are busy, deviant or hostile to taking part in research. Online observation is deemed necessary because the members of the online communities of practice are located in various locations throughout the country and the world; hence making direct face-to-face observations in their workplaces difficult. The term “online observation” is extracted from the works of Mann and Stewart (2000), who argued that qualitative researchers can observe the

linguistic behavior (both of what is said and how) of various kinds of computer-mediated communication usage, including both asynchronous and synchronous environments. As Mann and Stewart noted, “Clearly CMC [computer-mediated communication] offers an excellent site for qualitative researchers who observe discourse online” (p. 87). The observation of such discourses or interactions can help reveal participants’ ideas and attitudes toward a situation. Examples of studies that have employed online observation include: Denzin (1999) in his study of gendered “narratives of self” in a newsgroup, an asynchronous environment, focusing on alcoholic recovery; and Sharf (1999) in her examination of members’ conversations in a Breast Cancer listserv. In the current study, the data came from the online messages posted in APN-I for the first two weeks of each of the twelve months in 2005. The period of a two-week interval was chosen to keep the data corpus manageable for observation and analysis.

Interviews. Interviews were chosen as one of the data collection methods because the nurses’ experience of starting with the online community of practice was now in the past, and also because their perceptions and opinions could not be observed. According to Yin (2003), “interviews are an essential source of case study evidence since most case studies are about human affairs” (p. 92). The use of interviews can help describe people’s actions and behavior in their natural settings. We used the semi-structured interview format, where the interviews were focused and guided by issues pertinent to the study’s research questions.

Twenty-seven nurses (one male, twenty-six female) who are members of the APN-I participated in the study. Fourteen had more than twenty years of nursing experience; four had between fifteen and nineteen years; three had thirteen to fourteen years; while six had less than ten years. The collective experience base included experience in the following nursing areas: pediatric care, trauma, general medicine, cardiology, oncology, adult critical care and surgical

critical care. All participants had a graduate degree, with three having doctoral degrees. A majority of the participants (n=22) had participated for five or less years in APN-I (see Table 1 for the participant profiles).

- Insert Table 1 here -

Interview protocols were developed to gather data on the participants' backgrounds and experiences and to answer research questions (see Appendix A for the list of interview protocols). In addition, the interviews were conducted in conjunction with the online observations for triangulation purposes. For example, online observation results indicated the types of activity that participants engaged in with one another, while individual interviews provided opportunities for participants to elaborate on these activities and provide more detailed explanations. Each interview, lasting about 30-40 minutes, was conducted over the telephone. Informed consents to audio record the interviews were obtained from the participants.

Data analysis

To examine the types of activity and knowledge that nurses engage in/share with one another on the listserv, we used content analysis of online messages. Content analysis is a generic name for a variety of textual analyses that typically involve comparing, contrasting, and categorizing a set of data (Schwandt, 1997).

An important aspect of the content analysis method is identifying the appropriate unit of analysis, which is a discrete element of text that is observed, recorded, and thereafter considered data (Krippendorff, 1980). One means is to divide the online messages into "thematic units." A "thematic unit" is "a single thought unit or idea unit that conveys a single item of information extracted from a segment of content" (Budd, Thorp, & Donohue, 1967, p. 34). Our use of the thematic unit heeded the suggestion by Lincoln and Guba (1985) that the unit of analysis should

be heuristic and stand by itself. Our approach is also consistent with Merriam's (2001) recommendation that communication of meaning be the main focus. Each online message within the first two weeks of every month in 2005 was read in its entirety and then divided into various thematic units. One of the authors independently divided all messages into thematic units. Another independent coder (not involved in the current study) randomly reviewed approximately 10% of all thematic units. There was 78% agreement between the coders regarding the division of email messages into thematic units.

To determine the *types* of activity the nurses engage in, we used the constant-comparative method (Lincoln & Guba, 1985) on the thematic unit data corpus derived from the earlier content analysis of online messages. The coding scheme was not predetermined prior to our analysis but emerged inductively and was continually refined through our interaction with the data. Specifically, the constant-comparative method involves the following steps: examining the thematic units, forming categories, comparing categories, and achieving category saturation or exhaustion. For example, we began by selecting the first thematic unit, read it, and noted its content to form a tentative type of activity category. This first unit represented the first entry in the first tentative type of activity category. We then selected the next unit, read it, and noted its content. We determined whether its content was essentially similar with the first unit. If so, we placed the second unit with the first category and proceeded to the third unit; if not, the second unit represented the first entry in a new second tentative category. As we read each unit, we compared it to the existing categories and, at the same time reflected on the meaning of the categories. The result was that we constantly clarified our understanding of the types of activities that individuals engaged in. The two examples below illustrate how the data were coded.

The first example is: “How are you discarding empty bottles that have the patient’s information on them?” The example described here was placed into a “solicitation” type of activity category because the most salient element appeared to be the advanced practice nurse asking for help or ideas to solve a particular issue or problem.

The second example is: “Thank you for all the work it took to do this for us.” This example was put into an activity type category called “appreciation” because of the emphasis on offering thanks and gratitude to someone regarding some action done.

Analysis of the thematic unit data corpus continued until each emergent category was saturated or exhausted – meaning until new data began to confirm rather than shed new light on the existing types of activity categories. To ascertain the *reliability* of our types of activity coding, an independent coder was used to code approximately 10% of the total thematic units. These 10% units were randomly selected from the whole thematic unit data corpus. These were randomly chosen from the 1,190 units. The independent coder was not involved in the research study at all. The agreement percent was 87%.

To explore the types of knowledge that were shared by the nurses, we adopted Hara’s (2007) framework of knowledge types: book knowledge, practical knowledge, and cultural knowledge. However, we did not forcefully impose any of the coding categories onto the data corpus. In the course of our analysis, we also allowed for new knowledge categories to emerge inductively, if any, during the coding process. The two examples below illustrate how the data were coded.

The first example is: “You might want to talk to the people at XXX in Washington, DC.” This example was coded as sharing practical knowledge, specifically the “personal suggestion”

category because the most salient element appeared to be the sharing of one's own recommended solution to a problem or issue.

The second example is: "The reference is the New England Journal of Medicine, 345(19)..." This example was placed into the "book knowledge" category because of the emphasis on published works such as articles printed in a journal.

Using the constant-comparison method, analysis of the thematic unit data corpus continued until each knowledge type category was exhausted.

To understand the factors that sustain knowledge sharing among the nurses, we analyzed the nurses' interviews using the constant-comparative approach. The coding scheme in this case was not predetermined prior to our analysis but emerged through our interaction with the data. The two examples below illustrate how the interview data were coded.

The first example is: "Sharing knowledge helps me benchmark a lot of practices that I use in my organization." This example was placed into the factor of "validation of one's practice with others who shared a similar working situation" due to the emphasis on consulting other nurses in other organizations to see if the particular practices were also accepted by other organizations.

The second example is "It's convenient for people to respond when they like...it's also convenient for you to pose your question since you can do it at any time of the day or night." This example was placed into the factor of "asynchronous nature of the online communication medium" since the most salient element appeared to be the asynchronous technological feature of the listserv that afforded people the opportunity to share knowledge independent of the constraints of place and time.

Using the constant-comparison method, analysis of the interview data continued until each factor category was exhausted. At the conclusion of the analysis, we reviewed the categories to see that nothing had been overlooked. Any discrepancies related to the factors were resolved through our mutual discussion until a 100% agreement was reached.

The Advanced Practice Nurses Listserv as an Online Community of Practice

When viewed through Wenger's (1998) four lenses, APN-I may be considered an online community of practice, where online participation not only served as an avenue for knowledge sharing situated in the actual context of the nurses' everyday work experience, but also as an experience which helped reinforce the identity of practicing nurses.

The first characteristic of a community of practice is shared *practice* (Wenger, 1998), where members develop a shared repertoire of resources, such as experiences, stories, tools, and ways of addressing recurring problems (Wenger, 2001). Such a shared repertoire can be found in APN-I. This will be elaborated further in the following section when we describe the types of activities and knowledge that nurses shared in the APN-I listserv. It should be noted that the shared repertoire of resources was one of the main attractions that drew many nurses to be members of the listserv. Nurses, in particular, appreciated the fact that many of the country's top names in nursing are current members. These individuals are highly respected and well known in the nursing discipline and their contributions are well received by other members. Nurse H said, "The quality of the people that you actually get in touch with is just great. You can get nationally known people to comment or respond to your question, which you may not be able to do so elsewhere."

Besides having quality contributions from top authorities in the field, nurses also felt that the rich diversity of members in APN-I itself helped to foster a better repertoire of resources. For example, Nurse K remarked:

We really enjoy talking to other people [nurses] throughout the country...people with different backgrounds, experiences and opinions. We're sort of bred of the same institutions...we live in the same place [e.g. east coast]...but if we could talk to people of different settings, for example the west coast, we can get more interesting stories and ways of addressing a nursing issue.

The second characteristic of a community of practice is that members engage in discussions and sharing knowledge, which helps members develop a sense of being a part of a *community*. Online observations revealed that on average, about 138 messages were posted every month, or 35 messages each week. This shows that nurses in the APN-I were willing to interact with each other despite their busy workload. When asked why they participated in the APN-I, many said that it was a need to connect with other nurses (e.g., ask questions; seek pertinent knowledge). The listserv was a means of compensating for the isolation due to job function and geographic location (Gray, 2004; Walsh & Bayma, 1996). For some, APN-I functions as a lifeline to get outside knowledge and help. For example, Nurse E explained:

I'm the only critical care nurse specialist in my hospital, in the whole town as a matter of fact. As such, I don't have any contact with other [critical care] nurses in my town. This [APN-I] helps me to be in contact with other nurses from all across the country online on a regular basis. It allows me to ask questions.... It's a godsend to me because it helps me to validate my practice and get knowledge that I need quickly.

This was echoed by Nurse K who stated: “I feel fairly isolated [because] I don’t have many peers (advanced practice nurses) in my organization. The listserv helps give me ideas when I have no one else to bounce off ideas with in my hospital.” Nurse L similarly commented: “No one in my immediate area is doing exactly what I’m doing. Through the listserv, I’m able to access what other people are doing in other hospitals and regions. It also helps me keep current with nursing knowledge.”

The ability to interact online with peers is likely to gain prominence and importance in the near future given that the current shortages in critical care nursing personnel are projected to get far worse (Angus, Kelly, Schmitz, White, & Popovich, 2000; Buerhaus, Staiger, & Auerbach, 2000).

The third characteristic of a community of practice is *meaningful* learning developed through experience. The APN-I environment represented a valuable learning resource even for those who did not actively contribute through postings. The listserv was helpful for those who just “lurked” in the background and read what was being discussed, as nurse F put it:

I read the messages posted in the listserv every day. Almost 25%-30% of what I read, I’ve found useful and have incorporated into my actual practices. I don’t, however, post messages or contribute often ... perhaps once a month or so, and only when I need to ask questions or ... to contribute something useful that I know to whatever is being discussed.

Such participants were in fact engaged in “vicarious interaction” (Sutton, 2000), which Sutton defines as what “takes place when a participant actively processes both sides of a direct interaction between two other participants” (p. 4). This was also found in a study by Gray (2004) of an online community of practice designed to support informal workplace learning, where

participants “learned by lurking” and “picked up ideas” even when they only read the online postings but did not contribute themselves. Whittaker, Terveen, Hill, and Cherney (1998) suggest that lurking is a legitimate form of participation, an important transition mechanism for novices to learn about a new topic or social milieu. Nonnecke and Preece (2001) suggest that it is likely that at least some portion of lurking behavior is attributable to the process of coming up to speed on the workings of a group. By participating in the listserv, even lurkers vicariously experience being advanced practice nurses.

The fourth characteristic of a community of practice deals with their sense of *identity*. Nurses use the listserv to explore fundamentally important questions pertaining to the roles they play as critical care or advanced practice nurses. These roles, in turn, help shape their professional identities. Even nurses with over 20 years’ experience found use of the listserv meaningful and important. For example, nurse P said: “There are questions about professional development discussing issues on nurses’ roles and responsibilities [in the listserv]. Such discussion gives me some validity about what a nurse’s identity is when I talk to my director.” Nurse U echoed a similar opinion: “[Through the discussions] we can get to know what the national standard of advanced nurse practice is. This helps create a stronger identity of nurses.” In addition, membership in the APN-I is self-selected. People in such communities tend to know when and if they should join; they know if they have something to give and whether they are likely to take something meaningful away (Wenger & Snyder, 2000). Self-selection helps to establish a common culture among the APN-I members: the culture associated with being a critical care or advanced practice nurse. Commenting on how such culture is facilitated by the APN-I, nurse L remarked:

Culture is created in how nurses practice. It is like a big jigsaw puzzle, where communication among nurses is one part of it. The APN-L helps to build a piece of the culture puzzle by facilitating communication among its members.

In summary, APN-L may be considered an online community of practice. Participation in the listserv not only served as an avenue for interaction and knowledge sharing situated in the actual context of the nurses' everyday work experience (i.e., practice), but participation also helped to define the identities of practicing nurses.

Findings and Discussion

This section looks at the results and discusses their relevance in terms of the two research questions raised earlier.

Research Question 1(a): What types of activity did the nurses engage in on the listserv? (b) What types of knowledge did the nurses share with one another?

To examine Research Question 1 (a), a total of 1,059 message postings were obtained from the first two weeks of the months of January through December, 2005. Content analysis of these online messages resulted in 1,190 thematic units. Further analysis of these thematic units revealed ten types of activities that were commonly undertaken by the nurses. The ten types of activities were as follow:

1. Solicitation – request for help or ideas. For example: “How are you discarding empty bottles that have the patient’s information on them?”
2. Appreciation – offering thanks for some action. For example: “Thank you for all the work it took to do this for us.”

3. Administrative – related to the administrative purposes of the online listserv, as well as the use of the communication medium. For example: “We’re official!!! You don’t need to unsubscribe from the old”; “I’m testing the sending of messages to this medium.”
4. Job posting – announcement of some job openings or positions. For example: “I’m writing to you to spread word about a new program we are implementing. We are seeking at least two full-time advanced practice nurses to practice XXX medicine.”
5. Clarification – giving more pertinent details about a topic. For example: “I just need to clarify one thing on my request for information. Although we do use XXX bed occasionally, my question was regarding the YYY bed.”
6. Compliment – expressing praise or admiration. For example: “Congratulations XXXX for doing such a good job with the report.”
7. Empathy – Expressing feelings regarding the experience of another person. For example: “I’m so sorry to hear about your situation.”
8. Encouragement – Expressing words with the aim of inspiring another person with hope. For example: “Do hang in there and you’ll probably hear from them soon.”
9. Greetings – acknowledging someone. For example: “Hi XXXX! How’re you doing?”
10. Knowledge sharing – sharing book knowledge or practical knowledge.

The majority of the activity was “Knowledge sharing” (51.4%); followed by “Solicitation” (33.4%) (see Table 2). Further analysis revealed that “Knowledge sharing” was primarily a response to “Solicitation” (e.g., a query). The response to query ratio was approximately 1.68:1. Thus, more than one person responded to a query. This finding lends support that the APN-I community of practice demonstrates an active query-response discussion forum.

- Insert Table 2 here -

Changes in the relative frequency of each type of activity were also analyzed over the 12-month period, as illustrated in Figure 1. Here, the “Knowledge sharing” activity remained the most frequent category except in January and July. The overall average frequency of the “Knowledge sharing” activity across the 12 months was 55.8. “Solicitation” activities were the most frequent in January and July. The overall average frequency for the “Solicitation” activity was 33.2. The rest of the activities “Appreciation,” “Administrative,” “Job posting,” “Clarification,” “Compliment,” “Empathy,” “Encouragement,” and “Greetings” remained fairly low across the 12 months of 2005, with an average frequency of 1.9, 0.1, 6.1, 0.8, 0.4, 0.5, 0.3, and 0.1 respectively.

A point of interest is that there were few activities of “Empathy” and “Appreciation” found in the transcripts of postings. In a community of practice, it is not uncommon for people to exchange emotional support with others. However, the current data showed otherwise. Perhaps this was due to the very nature of an online environment, as opposed to a face-to-face environment. Research on computer-mediated discourse has repeatedly shown that online communities tend to be task-oriented and exchange less social-emotional information (Olaniran, Friedrich, & Vangrundy, 1992; Chidambaram, 1996; Jonassen & Kwon, 2001). Another possible reason for the few number of “Empathy” and “Appreciation” activities was that members might have engaged in such activities privately and directly with specific individuals, rather than sending such messages to the entire listserv to be seen by many. For example, online observations of messages showed some members trading their telephone numbers with one another; thus suggesting that telephone could have been used to convey their empathies and appreciations, as well as to share knowledge.

- Insert Figure 1 here -

In order to examine Research Question 1 (b) regarding sharing knowledge, two types of knowledge were found: book knowledge and practical knowledge.

1. Book knowledge – facts, general regulations, statutes, or published works. For example:

“The reference is the New England Journal of Medicine, 345(19)...”

2. Practical knowledge – book knowledge related to actual practice.

Practical knowledge can be further classified into one of the following three categories:

- A. Personal opinion – individual opinion not necessarily representing best practices. For example: “I believe that we should always assess for XXXX in every patient at every encounter.”
- B. Personal suggestion – personal recommended solution to a problem or issue based on professional background and experience. For example: “You might want to talk to the people at the XXX in Washington, DC.”
- C. Institutional practice – knowledge related to what an institution currently practices or has practiced in the past. For example: “In our setting, all of our patients receive XXXX. For our surgery patients, they have a pre-op XXXX, then daily XXXX.”

Analysis of the types of knowledge shared revealed that the most common was “Institutional practice” (53.5%) (see Table 3). “Personal opinion” came second (24.7%), followed by “Personal suggestion” (13.2%), and “Book knowledge” (8.7%).

- Insert Table 3 here -

The relatively low amount of “Book Knowledge” being shared among the nurses in the listserv was not very surprising given the fact that many of the members were already very knowledgeable in their content areas (a majority of the nurses have advanced degrees in

nursing). Typical types of book knowledge shared were the latest policies, regulations, or evidence-based literature pertaining to nursing practice. The fact that “cultural knowledge” was not evident in the online messages should not be construed as evidence of a lack of recognition within this category. “Cultural knowledge” was self-evident: each of the APN-I members were either critical care or advanced practice nurses, which perhaps eliminated the need for many explicit expressions of such knowledge in communication among the nurses.

The prominence of institutional practice sharing by members in APN-I might be due to the current professional mission in the nursing field that strongly requires advanced practice and critical nurses to base their practice on best practices and research evidence—what Sackett, Straus, Richardson, Rosenberg, and Haynes (2000) refer to as evidence-based medicine. Evidence-based medicine is the “practice of supporting clinical decision making with systematic research, while taking into account the personal values, unique biology, and individual concerns of each patient” (Hendler, 2004, p. 1). The nursing profession is basically a people-oriented profession with nurses having direct responsibility for their consumers (patients). Today’s patient expects and demands the best information available as well as a larger voice in determining the course of their health care choices and decisions—the result of over thirty years of a strong and still growing patient empowerment movement in the United States (Hendler, 2004). Institutional practice, which refers to knowledge related to an institution’s current and/or past practices, might constitute a larger portion of evidence-based medical knowledge than the nurses’ own personal opinions and personal suggestions, since it could be assumed that what was actually practiced by a hospital would be typically grounded on current best practices and research evidence. In general, we assume that members in APN-I would feel more comfortable sharing institutional practice, because it is something already established by individual institutions.

Changes in the relative frequency regarding the types of knowledge shared were also analyzed. Although “Institutional practice” fluctuated over the 12 months, it was remained the dominant type of knowledge shared among members. The overall average frequency of “Institutional practice” shared was 29.8, while the overall average frequency of “Personal opinion” was 13.8. The frequencies of “Book knowledge” and “Personal suggestion” averaged about 5 and 7 respectively.

- Insert Figure 2 here -

Research Question 2: What are the factors that sustain knowledge sharing among the nurses?

We identified the following six factors that sustain knowledge sharing from our analysis of interview data: (1) self-selection, (2) validation of one’s practice with others who shared a similar working situation, (3) a need to gain a better understanding of current knowledge and best practices in the field, (4) a non-competitive environment, (5) the asynchronous nature of the online communication medium, and (6) the role of the listserv moderator.

Self-selection. As mentioned previously, membership self-selection helps establish a sense of culture and identity among the members. Furthermore, because self-selection means that members choose to contribute to the community entirely of their own accord, members feel no sense of being pressured to share knowledge. As remarked by nurse H in an interview, “Contributing to the APN-1 community is a voluntary thing. People contribute because they themselves want to.” Knowledge sharing in the online community of practice thus proceeds informally and naturally.

Validation of one’s practice with others who shared a similar working situation. A community of practice’s domain is defined through its practice. This validation of practice is one of the important processes. Because many members of the APN-1 find themselves to be the sole

critical care or advanced practice nurse in their organizations or towns, sharing knowledge in an online community of practice is the only way to connect with other like nurses throughout the country. As Nurse V stated: “[Sharing of knowledge] helps me to benchmark a lot of practices that I use in my organization.”

A need to gain a better understanding of current knowledge and best practices in the field. In addition to providing professional assurance, a community of practice also allows its members to engage in knowledge building. We believe the need to share knowledge is particularly crucial to the critical care and advanced practice nursing fields. Our interview data revealed that the need to be cognizant of the current technology and best practices of their disciplines is one of the major challenges many nurses faced in the course of their work. Nurses felt that they gained knowledge as they shared their own. For example, Nurse X remarked:

I think that sharing knowledge is a two-way street. As I share my knowledge, I usually receive some comments and feedback to what I’ve shared. This back and forth sharing helps me have a better perspective of things. As a result, I gained a better understanding of an issue at the end.

Lesser and Storck’s study (2001), which used the local perspective approach, produced findings akin to the current study: participants were able to “respond... more rapidly to customer needs and inquiries” (p. 837). This was analogous to our third factor.

A non-competitive environment. The very nature of the communication medium also plays an important role in supporting and sustaining the online community of practice. When interviewed, many nurses stated that the online environment helped members have more willingness for sharing knowledge. This was mainly due to the non-competitive environment afforded by the online communication medium. Traditionally, organizations have rewarded their

employees based on their individual performance and know-how (Alavi & Leidner, 2001). In such situations, it is expected that individuals will attempt to build up and defend their own accumulated job-related knowledge rather than share with others (Von Krogh, 1998). However, distant and informal contact between professionals from *different* organizations might be an important mechanism to overcome such a barrier (Robertson, Swan, & Newell, 1996; Wasko & Faraj, 2005). Our interview data supported this view by revealing that some nurses, who worked in different organizations, felt that they were able to share knowledge easier due to the non-competitive character of the distributed online environment, simply because they were not in the same organization. Nurses felt that they did not have to hoard knowledge because there was no competition among them in terms of promotion or reward, since most were working in different organizations. As remarked by Nurse F:

I actually get better communication from my peers on the listserv. People are more willing to share things, especially when they are not your peers who may have ulterior motives...trying to work their way up the organization. You know what...they [people in the listserv] are not likely to run into you, and so they [are more likely] to tell you an honest opinion.

Asynchronous nature of the online communication medium. The asynchronous medium allows members to communicate with one another at any time and any place. For example, as Nurse K explained:

The Internet itself has made it so much easier to let people like us [on the east coast] to talk to people on the west coast. You can just like throw something off at the listserv and get people from all over the country to respond to you quickly [rapid turnaround time]. It's convenient for the people to respond when they

like...it's also convenient for you to pose your question, since you can do it at any time of the day or night you want.

Our interview data support observations made by other researchers that listservs have the potential to enhance communication because they are independent of the constraints of place and time in traditional face-to-face settings (Althaus, 1997; Harasim, 1987; Quinn, Mehan, Levin, & Black, 1983).

Although the asynchronous nature of using a listserv may help sustain knowledge sharing, it is also important to note that there can be disadvantages associated with its use. The use of a text-based medium can be difficult for individuals to express certain ideas clearly in words. For example, Nurse R explained: "Sometimes I find it difficult to communicate some things clearly in words and I may run the risk of being misunderstood by someone else." Additionally, since knowledge is such an important component of individual self-efficacy and personal self-image, any listserv attacks on an individual's ideas may be viewed as attacks on the individual and damage knowledge sharing (Wasko & Faraj, 2000).

Role of the listserv moderator. Data from the interviews and online observations also indicate that the majority of members perceived the pivotal role of the moderator. This finding corroborates with Gray's (2004) conclusions that the role of a moderator can be an important factor in facilitating and sustaining knowledge sharing in an online community. First, members appeared to value the moderator's efforts in getting members "up and running" easily and quickly with the new *Yahoo! Group software* online communication environment. The moderator was observed sending out messages offering personal help assisting members' access to the new site. It is likely that such forms of assistance helped pave the way for members in APN-1 to be able to use the listserv technology easily. Perceived ease of use is defined as "the

degree to which an individual believes that using a particular system would be free of physical and mental effort” (Davis, 1993, p. 477). Perceived ease of technology has been found to encourage people to share knowledge (Soo, 2006).

Second, by acting as a sieve or filter through which all messages are screened before they are posted on the listserv, the moderator helps keep communication focused on professional issues pertinent to critical care and advanced practice nursing fields. As remarked by Nurse B, “[The moderator] is very careful in taking care of the APN-1 discussion.” Nurse F added, “Personal issues unrelated to the listserv are kept out mainly by the effort of the moderator.” An interview with the moderator revealed that commonly rejected messages are those that seek to exploit APN-1 members (e.g., recruitment for some self-serving purposes); this does not include genuine job postings which can be useful for the APN-1 members.

Third, by acting as a “watchdog” of netiquette, the moderator helps keep communication civil and respectful. For example, the moderator explained in an interview that unprofessional statements (e.g., personal attacks on a member) are frowned upon, and that she is quick to caution those responsible. The moderator confirmed that such incidents are, however, rare—they seem to happen only about once a year.

- Insert Table 4 here -

Table 4 presents the comparison between the six factors identified in this research and Wenger’s four characteristics of a community of practice. The first and second factors, self-selection and validation of one’s practice, resonate with and support identity in Wenger’s framework. Self-selection is based on the existing identity as advanced practice nurses while validation of practice leads to development of identity. The third factor, better understanding of current knowledge and best practice in the field, is embedded in practice, which makes learning

meaningful. The fourth and sixth factors, a non-competitive environment and the role of the listserv moderator, both help develop a sense of community. The fifth factor, however, refers to a characteristic of a technology, which does not directly relate to any of Wenger's characteristics. This raises an argument that we do need to consider technological characteristics of online communities of practice in addition to the ones based on face-to-face communities of practice developed by Wenger (1998) and his successors.

Furthermore, these six factors are quite different from the factors identified by Wasko and Faraj (2005) although two factors can be considered closely related to Wasko and Faraj's model. The non-competitive environment (i.e., fourth factor) may be related to relational capital identified in Wasko and Faraj's model although this factor was not explicitly mentioned and supported by the data in their study. Additionally, the sixth factor regarding the rule of the moderator can be applicable to centrality in structural capital described in Wasko and Faraj's model. Four other factors (i.e., self-selection, validation of one's practice, a need to gain a better understanding of current knowledge, and asynchronicity of the technology) were not described in Wasko and Faraj's model, thus indicating a possible difference between the *a priori* framework (i.e., Wasko and Faraj's model) and local perspectives (i.e., our findings).

Relationships among the six factors

Finally, we briefly discuss the possible relationships among the six factors that were identified (Figure 3). We conjecture that self-selection and non-competitiveness may be considered as critical components of the listserv social environment. Validation of practice and the need to gain a better understanding of current knowledge constitute key elements of an individual's needs, while asynchronicity is a key component of the listserv's technological

features. Together, these three constructs (i.e., listserv social environment, individual needs, and technological features) sustain knowledge sharing in APN-I.

- Insert Figure 3 here -

Self-selection and non-competitiveness may be related to each other. Self-selection membership implies that individuals join a community of practice voluntarily and share knowledge on their own accord. We conjecture that an individual's needs directly influence self-selection membership (see Figure 3). For example, people join APN-I voluntarily because of the need to gain validation of their own professional practice and to engage in knowledge building so as to stay informed of the current technology and best practices of the nursing discipline. It is likely that self-selection membership helps guarantee a more serious group who has a genuine interest in the discussion that takes place (Smith 2003), and hence is less concerned about the issue of competing for reward or recognition for their knowledge contribution. The role of the listserv moderator may be considered as a watchdog of self-selection membership, helping to ensure that inappropriate individuals (e.g., advertisers) are kept out. The validation of one's own practice and the need to gain a better understanding of the current knowledge and best practices in the field may also influence each other. It is likely that cognizance of the best current practices can help one better benchmark one's own practice with other nurses in the field.

Conclusion

The findings in this study suggest that the most common type of activity undertaken by nurses in a listserv was "Knowledge sharing," followed by "Solicitation." While further examining "Knowledge sharing" messages regarding the types of knowledge shared, the most common ones were "Institutional practice" and "Personal opinion." The factors that helped sustain knowledge sharing within the online community of practice include: (1) the self-

selection, (2) validation of one's practice with others who shared a similar working situation, (3) a need to gain a better understanding of current knowledge and best practices in the field, (4) the non-competitive environment, (5) the asynchronous nature of the online communication medium, and (6) the role of the listserv moderator.

One limitation of the current study was that we only interviewed nurses who were willing to participate in the research. As a result, the findings reported in the paper may have been biased in terms of the nurses being favorable towards the APN-I listserv. It would therefore be useful to examine the perceptions and opinions of novice nurses and nurses who have since left the APN-I listserv. Another limitation of the study was the relatively small number of participants ($n=27$). Consequently, the conclusions need to be viewed with caution as it would not be representative of all nurses in APN-I. Finally, because the data analyzed from online observation was based on the first two weeks of each month in 2005, this approach possibly introduced a sampling bias.

Despite these limitations, we believe that the findings are useful not only to advanced practice nurses, but also to other professionals. For example, administrators of organizations can use the coding schema developed in this study to gauge the current activities (e.g., types of activities and knowledge) of existing online communities of practice. In addition, they can use the six factors for a sustainable knowledge sharing community identified in this study as a guideline to foster new or existing online communities of practice.

Future studies can take several different directions. First, research should be conducted in other online communities of practice. The current study was conducted with advanced practice nurses in advanced and critical care fields that stress the need for members to be cognizant of current best practices and current literature (Sackett et al., 2000). This profession necessitates knowledge that is rapidly changing. Future studies should examine listservs that place less

emphasis on such need. For example, a profession that is based on more stable and traditional knowledge such as craftsmanship (Cook & Yanow, 1996) would be a good comparison. Furthermore, health-care professions are service-oriented. Another interesting comparison would be to study a product-oriented profession such as programming or manufacturing. The requirement for continuing education is another dimension to diversify professions.

Second, there is a need for future research to confirm that our six factors that sustain knowledge sharing apply across various other disciplines. Are there other important factors that need to be considered? Also, future research may consider comparing two sites, one with and one without some of the factors that sustain knowledge sharing, in order to isolate which are most important. Third, future studies might also consider the relative importance of each of the six factors within the *various stages* of an online community of practice life span. Wenger (1998b) delineates five stages of development through which a community of practice moves: (1) potential—when people find each other and discover similarities of interest and practice; (2) coalescing—when members begin to get together and recognize their potential; (3) active—when members engage actively in developing a practice; (4) dispersed—when members no longer engage intensely with each other but the community is still alive as a center of knowledge; and (5) memorable—when the community of practice is no longer central. Which of the six success factors are more critical and applicable during each development stage of an online community of practice's life span seems an interesting question.

Fourth, there is a need to determine if these six success factors are present in situations where an online community is deliberately created rather than where an online community has simply emerged. As Johnson (2001) noted, “no study reviewed approached the creation of a virtual community with a deliberate view towards a community of practice” (p. 56). He

suggested that a case study be developed to examine the discrepancies between the intended design and the emergent usage of a community of practice. In such a case study, following Johnson, questions that could be considered include: in what ways do the six factors affect the emergence of communities of practice within an online community? Which of the six factors are necessary to sustain an online community of practice? Finally, future research should empirically examine and verify the possible relationships illustrated in Figure 3.

Many professionals struggle to keep up with a rapidly changing knowledge base. Online communities of practice are a means to support such professionals. We hope that this study will contribute to the further understanding of knowledge sharing via online communities of practice.

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References

- Alavi, M., Leidner, D. E. (2001), "Knowledge management and knowledge management systems: Conceptual foundations and research issues", *MIS Quarterly*, Vol. 25 No. 1, pp.107-136.
- Althaus, S. (1997), "Computer-mediated communication in the university classroom: An experiment with online discussions", *Communication Education*, Vol. 46 No. 3, pp. 158-174.
- Angus, D. C., Kelly, M. A., Schmitz, R. J., White, A., Popovich, J. J. (2000), "Current and projected workforce requirements for care of the critically ill and patients with pulmonary disease: Can we meet the requirements of an aging population?" *Journal of the American Medical Association*, Vol. 284 No. 21, pp. 2762-2770.

- Ardichvili, A., Page, V., Wentling, T. (2003), „Motivation and barriers to participation in online knowledge-sharing communities of practice”, *Journal of Knowledge Management*, Vol. 7 No. 1, pp. 64-77.
- Baek, E. O. (2002). *A study of dynamic design dualities in a web-supported community of practice for teachers*. Unpublished doctoral dissertation. Indiana University.
- Barab, S. A., MaKinster, J. G., Scheckler, R. (2003), “Designing system dualities: Characterizing an online professional development community”, *The Information Society*, Vol. 19 No. 3, pp. 347-256.
- Biggam, J. (2001). *Defining knowledge: An epistemological foundation for knowledge management*. Proceedings of the 34th Hawaii International Conference on System Sciences. Computer Society Press. Available at <http://csdl2.computer.org/comp/proceedings/hicss/2001/0981/07/09817070.pdf>
- Brown, J. S., Duguid, P. (1991), “Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation”, *Organization Science*, Vol. 2 No. 1, pp. 40-57.
- Budd, R., Thorp, R., Donohew, L. (1967), *Content analysis of communication*. Macmillan, New York.
- Buerhaus, P. I., Staiger, D. O., Auerbach, D. I. (2000), “Implications of an aging registered nurse workforce”, *Journal of the American Medical Association*, Vol. 283, No. 22, pp. 2948-2954.
- Chao, C. A. (2001). *Workplace learning as legitimate peripheral participation: A case study of newcomers in a management consulting organization*. Unpublished doctoral dissertation. Indiana University.

- Chidambaram, L. (1996), "Relational development in computer supported groups", *MIS Quarterly*, Vol. 20 No. 20, pp. 443-470.
- Cook, S. D. N., Yanow, D. (2006), "Culture and organizational learning", in Cohen, M.D. and Sproull, L. S. (Eds.), *Organizational learning*, Sage Publications, Thousands Oaks, CA, pp.430-459.
- Cox, A. (2005), "What are communities of practice? A comparative review of four seminal works", *Journal of Information Science*, Vol. 31 No. 6, pp. 527-540.
- Davenport, E. (2001), "Knowledge management issues for online organizations: 'Communities of practice' as an exploratory framework", *Journal of Documentation*, Vol. 57 No. 1, pp. 61-75.
- Davis, F. D. (1993), "User acceptance of information technology: system characteristics, user perceptions and behavioral impacts", *International Journal of Man-Machine Studies*, Vol. 38 No. 3, pp. 475-487.
- Denzin, N. (1999), "Cybertalk and the method of instances", in Jones, S. (Ed.), *Doing Internet Research: Critical issues and methods for examining the net*, Sage Publications, Thousand Oaks, CA, pp. 107- 125.
- Dubé, L., Bourhis, A., Jacob, R. (2005), "The impact of structuring characteristics on the launching of virtual communities of practice", *Journal of Organizational Change and Management*, Vol. 18 No. 2, pp. 145-166.
- Foster, P. (1996), "Observational research", in Sapsford, R. and Jupp, V. (Eds.), *Data Collection and Analysis*, Sage Publications, London and Thousand Oaks, CA, pp. 57-93.
- Gray, B. (2004), "Informal learning in an online community of practice", *Journal of Distance Education*, Vol. 19 No. 1, pp. 20-35.

- Haney, D. S. (2003). *Knowledge management in a professional service firm*. Unpublished doctoral dissertation, Indiana University, Bloomington.
- Hara, N. (2000). *Social construction of knowledge in professional communities of practice: Tales in courtrooms*. Unpublished doctoral dissertation. Indiana University.
- Hara, N. (2007), "IT support for communities of practice: How public defenders learn about winning and losing in court", *Journal of the American Society for Information Science and Technology*, Vol. 58 No. 1, pp. 76-87.
- Harasim, L. (1987), "Teaching and learning online: Issues in computer-mediated graduate courses", *Canadian Journal of Educational Communication*, Vol. 16 No. 2, pp. 117-135.
- Hendler, G. Y. (2004), "Why evidence-based medicine matters to patients?" *Journal of Consumer Health on the Internet*, Vol. 8 No. 2, pp. 1-14.
- Hendriks, P. (1999), "Why share knowledge? The influence of ICT on the motivation for knowledge sharing", *Knowledge and Process Management*, Vol. 6 No. 2, pp. 91-100.
- Hildreth, P., Kimble, C., Wright, P. (2000), "Communities of practice in the distributed international environment", *Journal of Knowledge Management*, Vol. 4 No. 1, pp. 27-37.
- Horvath, J. A. (1999), "Tacit knowledge in the professions", in Sternberg, R. J. and Horvath, J. A. (Eds.), *Tacit knowledge in professional practice*, Lawrence Erlbaum, Mahwah, NJ, pp. ix-xiii.
- Hung, D., Tan, S. C., Hedberg, J. G., Koh, T. S. (2005), "A framework for fostering a community of practice: Scaffolding learners through an evolving continuum", *British Journal of Educational Technology*, Vol. 36 No. 2, pp. 159-176.
- Huysman, M., Wulf, V. (2006), "IT to support knowledge sharing in communities, towards a social capital analysis", *Journal of Information Technology*, Vol. 21, pp. 40-51.

- Johnson, C. M. (2001), "A survey of current research on online communities of practice", *The Internet and Higher Education*, Vol. 4 No. 1, pp. 45-60.
- Jonassen, D. H., Kwon, H. I. (2001), "Communication patterns in computer-mediated vs. face-to-face group problem solving", *Educational Technology Research and Development*, Vol. 49 No. 1, pp. 35-51.
- Keane, B. T., Mason, R. M. (2006), "*On the nature of knowledge. Rethinking popular assumptions*", Proceedings of the 39th Hawaii International Conference on System Sciences. Computer Society Press. Available at <http://csdl2.computer.org/comp/proceedings/hicss/2006/2507/07/250770162b.pdf>
- Kogut, B., Zander, U. (1993), "Knowledge of the firm and the evolutionary theory of the multinational corporation", *Journal of International Business Studies*, Vol. 24 No. 4, pp. 625 – 645.
- Krippendorff, K. (1980), *Content analysis: An introduction to its methodology*, Sage Publications, Beverly Hills, CA.
- Lamb, R., King, J. L., Kling, R. (2003), "Informational environments: Organizational contexts of online information use", *Journal of the American Society for Information Science and Technology*, Vol. 54 No. 2, pp. 97-114.
- Lave, J., Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*, Cambridge University Press, Cambridge.
- Lesser, E. L., Storck, J. (2001), "Communities of practice and organizational performance", *IBM Systems Journal*, Vol. 40 No. 4, pp. 831-841.
- Leonard, D., Sensiper, S. (1998), "The role of tacit knowledge in group innovation", *California Management Review*, Vol. 40 No. 3, pp. 112-132.

- Lincoln, Y. S., Guba, E. G. (1985), *Naturalistic inquiry*, Sage Publications, Beverly Hills, CA.
- Ling, K, Beenen, G., Ludford, P., Wang, X., Chang, K., Li, X., Cosley, D., Frankowski, D., Terveen, L., Rashid, A. M., Resnick, P., Kraut, R. (2005), "Using social psychology to motivate contributions to online communities", *Journal of Computer-mediated communication*, Vol. 10 No. 4. Available at <http://jcmc.indiana.edu/vol10/issue4/ling.html>
- Mann, C., Stewart, F. (2000), *Internet communication and qualitative research: A handbook for researching online*, Sage Publications, London.
- Merriam, S. B. (2001), *Qualitative research and case study applications in education*, Jossey-Bass, San Francisco.
- Nonaka, I., Konno, N. (1998), "The concept of "ba": Building a foundation for knowledge creation", *California Management Review*, Vol. 40 No. 3, pp. 40-54.
- Nonaka, I., Takeuchi, H. (1995), *The knowledge creating company*, Oxford University Press, New York.
- Nonnecke, B., Preece, J. (2001), "Why lurkers lurk". Paper presented at the Americas Conference on Information Systems, August 3 - 5, Boston: MA.
- Olaniran, B.A., Friedrich, G. W., Van Grundy, A. B. (1992, May), "Computer mediated communication in small group decisional stages", Paper presented at the 42nd meeting of the American Educational Research Association, Boston, MA.
- Orr, J. (1996), *Talking about machines: An ethnography of a modern job*, ILR Press, Ithaca, NY.
- Polanyi, M. (1966), *The tacit dimension*, Routledge & Kegan Paul, London.
- Quinn, C. N., Mehan, H., Levin, J. A., Black, S. D. (1983), "Real education in non-real time: The use of electronic message system for instruction", *Instructional Science*, Vol. 11 No. 4, pp. 313-327.

- Robertson, M., Swan, J., Newell, S. (1996), "The Role of networks in the diffusion of technological innovation", *Journal of Management Studies*, Vol. 33, pp. 335-361.
- Ruhleder, K., Jordan, B., Elmes, M. B. (1996), "Wiring the "new organization": Integrating collaborative technologies and team-based work", Paper presented at the Annual Meeting of the Academy of Management.
- Sackett, D. L., Straus, S. E., Richardson, W. S., Rosenberg, W., Haynes, R. B. (2000), "Evidence-based medicine: How to practice and teach EBM", (2nd ed.), Churchill Livingstone, Edinburgh.
- Schultze, U., Leidner, D. E. (2002), "Studying knowledge management in information systems research: Discourses and theoretical assumptions", *MIS Quarterly*, Vol. 26 No. 3, pp. 213-242.
- Schwandt, T. A. (1997), *Qualitative inquiry: A dictionary of terms*, Sage Publications, Thousand Oaks, CA.
- Sharf, B. F. (1999), "Beyond netiquette. The ethics of doing naturalistic discourse research on the Internet", in Jones, S. (Ed.), *Doing internet research: Critical issues and methods for examining the net*, Sage Publications, Thousand Oaks, CA, pp. 243- 256.
- Sharratt, M., Usoro, A. (2003), "Understanding knowledge-sharing in online communities of practice", *Electronic Journal on Knowledge Management*, Vol. 1 No. 2, pp. 187-196.
- Smith, M. K. (2003). Communities of practice. *The encyclopedia of informal education*. Available at http://www.infed.org/biblio/communities_of_practice.htm
- Soo, K. S. (2006). *Why workers share knowledge: A case study*. Unpublished doctoral dissertation. Indiana University.

- Sutton, L. (2000). *Vicarious interaction in a course enhanced through the use of computer-mediated communication*. Unpublished doctoral dissertation. Arizona State University, Tempe.
- Von Krogh, G. (1998), "Care in knowledge creation", *California Management Review*, Vol. 40 No. 3, pp. 133-153.
- Walsh, J. P., Bayma, T. (1996), "Computer networks and scientific work", *Social Studies of Science*, Vol. 26, pp. 661-703.
- Wasko, M., Faraj, S. (2000). "'It is what one does:' Why people participate and help others in electronic communities of practice", *Journal of Strategic Information Systems*, Vol. 9, pp. 155-173.
- Wasko, M. M., Faraj, S. (2005), "Why should I share? Examining social capital and knowledge contribution in electronic networks of practice", *MIS Quarterly*, Vol. 29 No. 1, pp. 35-57.
- Wenger, E. (1990). *Toward a theory of cultural transparency: Elements of a social discourse of the visible and the invisible*. Unpublished doctoral dissertation, University of California Irvine.
- Wenger, E. (1998), *Communities of practice: Learning, meaning, and identity*, Cambridge University Press, New York.
- Wenger, E. (2001). *Supporting communities of practice: A survey of community-oriented technologies*. Available at <http://www.ewenger.com/tech/>
- Wenger, E., Snyder, W. M. (2000), "Communities of practice: The organizational frontier", *Harvard Business Review*, Vol. 78 No. 1, pp. 139-145.
- Wenger, E., McDermont, R., Snyder, W. M. (2002), *"Cultivating communities of practice"*, Harvard Business School Press, Boston, MA.

- Wensley, A. K. P. (2000), "Tools for knowledge management", in Chauvel, D. and Despres, C. (Eds.), *Proceedings of the BPRC 2000 Conference on Knowledge Management: Concepts and Controversies* (Butterworth-Heinemann, Warwick, 2000), p. 21.
- Whittaker, S., Terveen, L., Hill, W., Cherny, L. (1998) The dynamics of mass interaction. *Proceedings of Computer Supported Cooperative Work 98*, Seattle, WA, ACM Press, pp. 257-264.
- Yi, J. Q. (2000). *Supporting business by facilitating organizational learning and knowledge creation in the MOT community of practice (CoP)*. Unpublished doctoral dissertation, Indiana University.
- Yin, R. K. (2003), *Case study research: Design and methods* (3rd ed.), Sage Publications, Thousand Oaks, CA.
- Zeldin, T. (1998), *Conversation: How talk can change our lives*, Harville Press, London.

Table 1. Characteristics of the 27 participants in APN-1

Participant	Gender	Years of experience	Years in APN-1	Highest education	Areas of specialty
Nurse A	F	25	10	Master	Pediatric care
Nurse B	F	25	8	Master	Pediatric care
Nurse C	F	8	1	Master	Trauma, general medicine
Nurse D	F	25	2	Master	Patient safety
Nurse E	F	25	4	Post-master	Cardiology
Nurse F	F	21	1.5	Master	Adult surgical
Nurse G	F	29	5	Master	Cardiology
Nurse H	F	25	9 months	Master	General ICU
Nurse I	M	16	3	Master	Surgical critical care
Nurse J	F	17	7	Master	Medical critical care
Nurse K	F	18	4	Master	Adult critical care
Nurse L	F	9	3	Master	Acute care
Nurse M	F	27	4	Master	Oncology
Nurse N	F	8	2	Master	Surgical critical care
Nurse O	F	14	2	Bachelor	Critical care
Nurse P	F	7	1.5	Master	Cardiology critical care
Nurse Q	F	21	1.5	Master	Trauma
Nurse R	F	13	1.5	Master	Cardiac surgery
Nurse S	F	23	10	Doctorate	Adult critical care
Nurse T	F	2.5	1.5	Doctorate	Critical care

Table 1 (Continue)

Participant	Gender	Years of experience	Years in APN-1	Highest education background	Areas of specialty
Nurse U	F	14	3	Master	Cardiovascular critical care
Nurse V	F	27	1	Master	Nursing education
Nurse W	F	23	2 months	Master	Neurology
Nurse X	F	8	2	Master	Nursing education
Nurse Y	F	17	3	Master	Trauma, neural
Nurse Z	F	30	10	Doctorate	Critical care
Nurse AA	F	37	9	Master	Cardiovascular

Table 2. Types of activities and frequency

Types of activities	Frequency	Percent
Solicitation	398	33.4%
Appreciation	23	1.9%
Administrative	1	0.1%
Job posting	73	6.1%
Clarification	10	0.8%
Compliment	5	0.4%
Empathy	6	0.5%
Encouragement	4	0.3%
Greeting	1	0.1%
Sharing knowledge	669	56.2%

Table 3. Types of knowledge and frequency

Types of knowledge	Frequency	Percent
Book knowledge	58	8.7%
Personal opinion	165	24.7%
Personal suggestion	88	13.2%
Institutional practice	358	53.5%
Cultural knowledge	0	0

Table 4: Comparison of six factors that sustain knowledge sharing among nurses and Wenger's four characteristics of a community of practice

Factors that sustain knowledge sharing	Wenger's four characteristics of a community of practice
Self-selection	Identity
Validation of one's practice	Identity
Better understanding of current knowledge & best practice in the field	Practice/ Meaning
Non-competitive environment	Community
Asynchronous nature of the online communication medium	
Role of the listserv moderator	Community

Figure 1. Changes of the types of activity over time

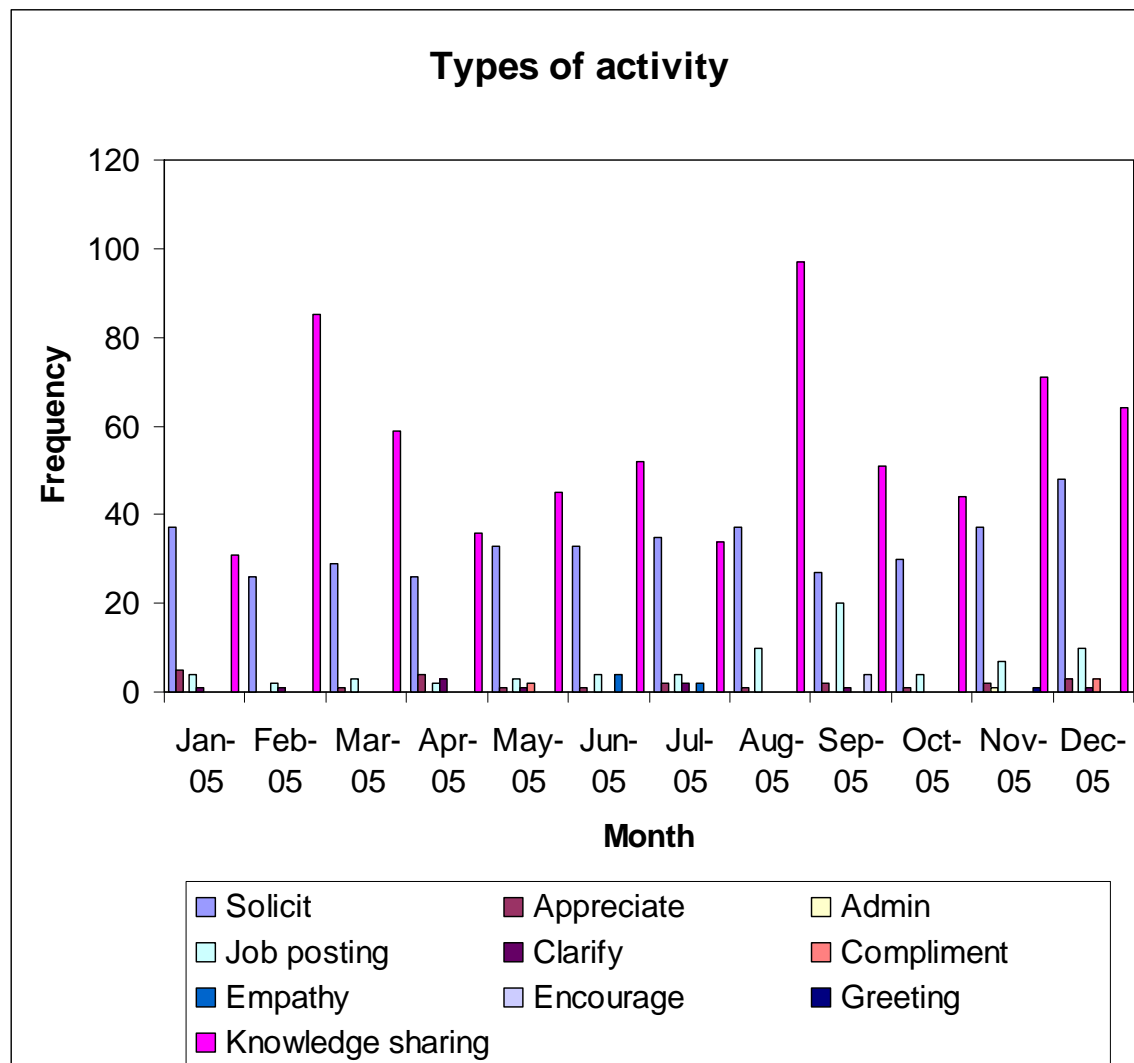


Figure 2. Changes of the types of knowledge over time

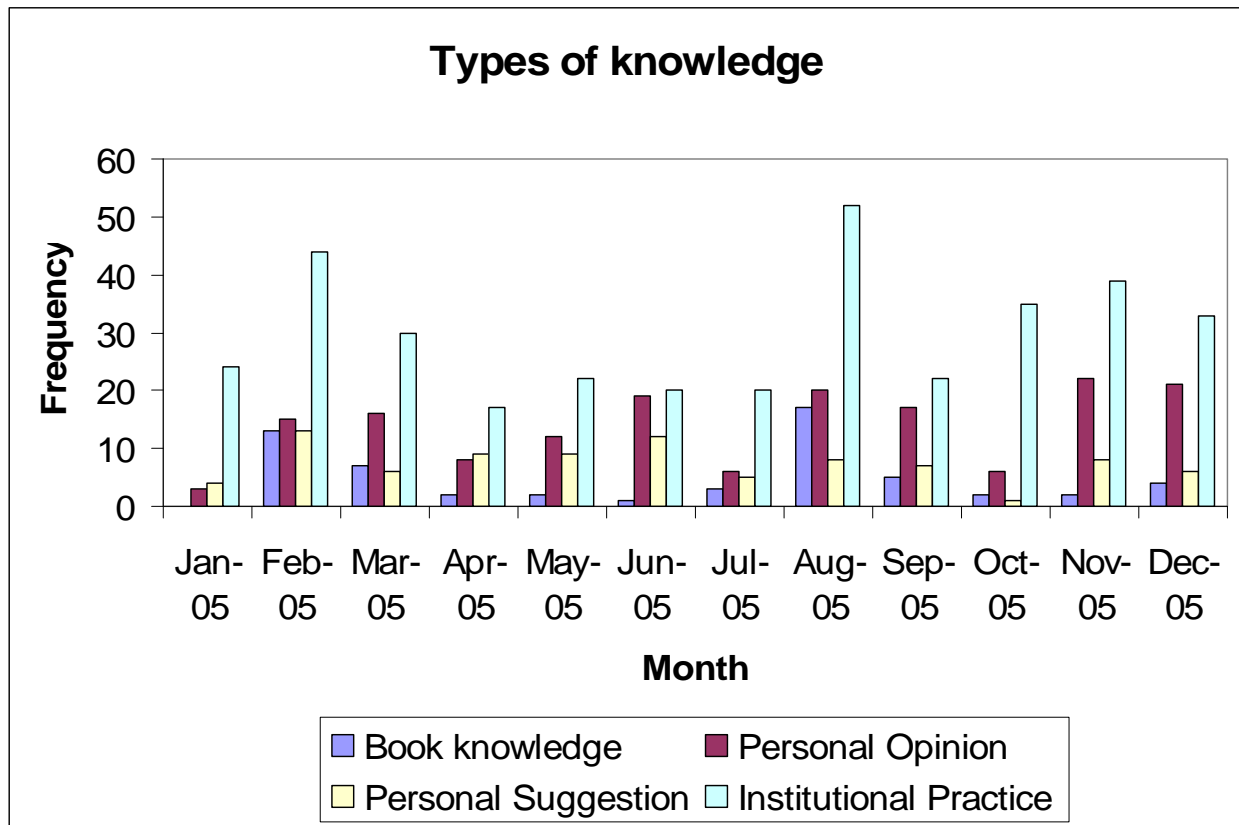
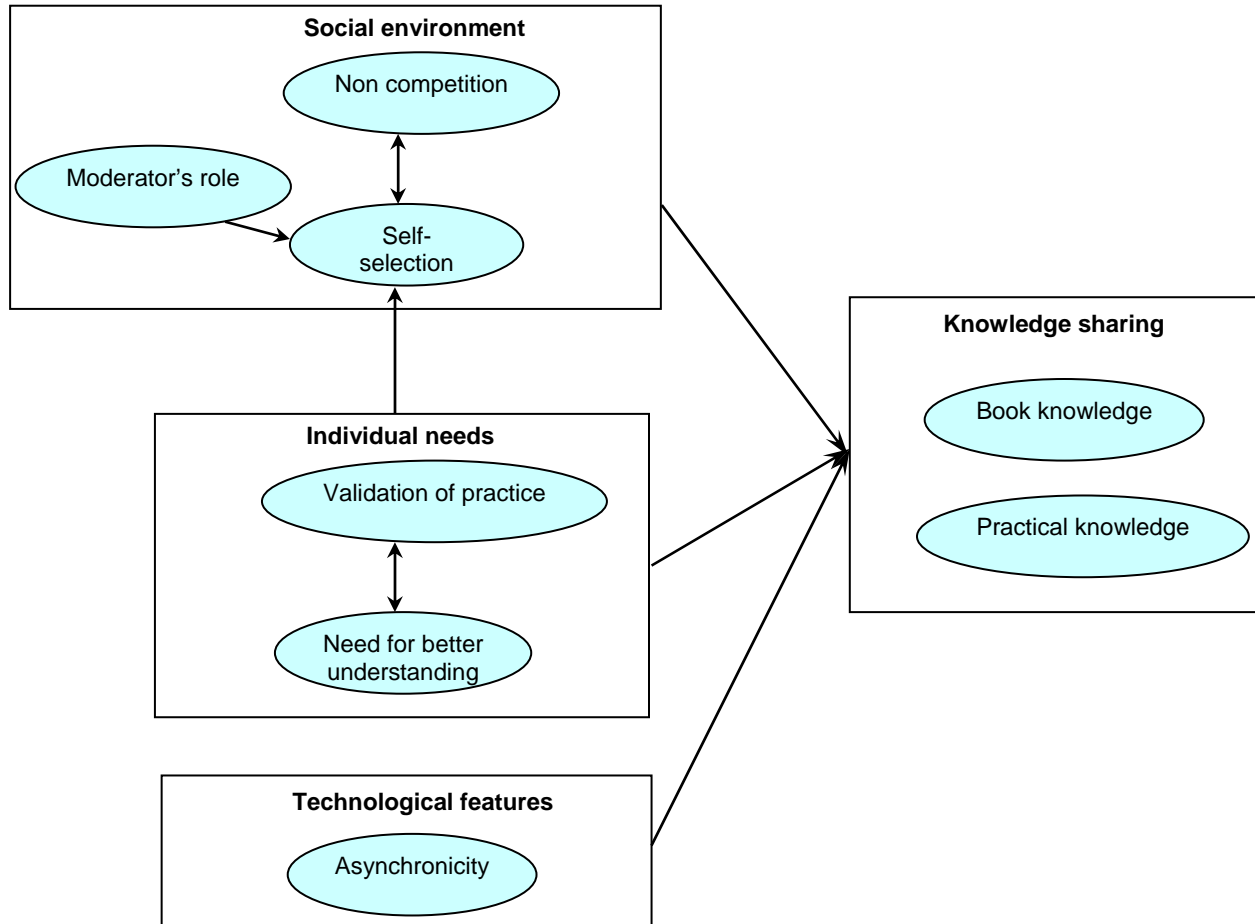


Figure 3. Possible relationships among the six identified factors



Appendix

1. How long have you been working as an advanced practice nurse? and in your current organization?
2. What are some of the challenges that you face as an advanced practice nurse?
3. What is your educational background?
4. How long have you been on the APN-I?
5. What made you participate on the APN-I?
6. How comfortable are you in participating in APN-I? Why?
7. How does APN-I help build a domain of shared interest? Does it help formulate a sense of professional identity of nurses?
8. What types of activity do you typically engage in APN-I?
9. What types of knowledge are important to your practice?
10. Are these types of knowledge being shared in your own organization? How are they shared?
What about in APN-I?
11. What are the differences in sharing knowledge in APN-I versus in your own organization?
12. How do you think the culture of APN-I sustain knowledge sharing?
13. How do you judge the quality of the ideas shared in APN-I?
14. What are the factors that make APN-I successful?
15. What do you like about APN-I? What about your dislikes?
16. Is there anything else you can tell me about APN-I?

Explanation for the interview questions:

Questions #1, 3, 4 served to gather the participants' demographic information, as well as conversation starters. Question #2 helped us better understand some of the struggles and

challenges advanced practice nurses face, and how a CoP may help them. Question #5 helped yield data on research question (RQ) 2. For example, some participants indicated that they participated (which included sharing knowledge) because they wanted to gain a better understanding of the current best practices in the nursing field. Question #6 also yielded data on RQ 2. For example, some participants commented that they felt comfortable participating (including sharing knowledge) because of the non-competitive nature of the listserv environment. Question #7 helped to answer whether the listserv fulfilled the fourth characteristic of a CoP – sense of identity. Questions #8 – 10 helped to answer RQ 1(a) and 1(b). Question #11 yielded data on RQ 2, particularly about the issue of non-competitiveness in APN-I versus competitiveness in the participants' own organizations. Questions #12, 14, 15, and 16 yielded data on RQ 2, particularly about the self-selection membership of APN-I, role of the moderator, and the asynchronous nature of the technology. Additionally, question #15 yielded data on what the participants disliked about the use of the listserv technology (e.g., the text-based medium causing some misunderstanding among individuals). Question #13 helped yield data on the first characteristic of a CoP – development of a high quality shared repertoire of resources (e.g., ideas and suggestions to solve a work problem). Nurses judged the quality of the ideas by looking at the names and positions of the idea contributors. Nurses appreciated that many of the country's top names in nursing are current members, and their contributions were well-received by other members.